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UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
CNA-018-DIVTotal Pages in this Submission
44

TO THE ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

PRECISION CONTINUOUS SURFACE GUIDED OPTICAL MODULE CARRIER AND METHOD OF USING SAME

and invented by:

CHANDLER, ET AL.

If a CONTINUATION APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application No.: 09/144,434

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.:

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.:

Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 28 pages and including the following:
 - a. ☒ Descriptive Title of the Invention
 - b. ☐ Cross References to Related Applications (if applicable)
 - c. ☐ Statement Regarding Federally-sponsored Research/Development (if applicable)
 - d. ☐ Reference to Microfiche Appendix (if applicable)
 - e. ☒ Background of the Invention
 - f. ☒ Brief Summary of the Invention
 - g. ☒ Brief Description of the Drawings (if drawings filed)
 - h. ☒ Detailed Description
 - i. ☒ Claim(s) as Classified Below
 - j. ☒ Abstract of the Disclosure

UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

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Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)
- a. ☒ Formal Number of Sheets 7
- b. ☐ Informal Number of Sheets _____
4. ☒ Oath or Declaration
- a. ☐ Newly executed (original or copy) ☐ Unexecuted
- b. ☒ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☐ With Power of Attorney ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application,
see 37 C.F.R. 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (usable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Computer Program in Microfiche (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all must be included)
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy (identical to computer copy)
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(B) Statement (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☒ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations
12. ☒ Preliminary Amendment
13. ☒ Acknowledgment postcard
14. ☒ Certificate of Mailing
- ☐ First Class ☒ Express Mail (Specify Label No.): EL358870406US

UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

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Accompanying Application Parts (Continued)

15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)

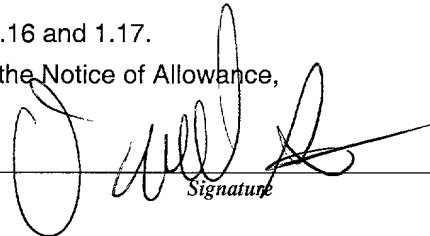
16. ☐ Additional Enclosures (please identify below):

Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	16	- 20 =	0	x \$18.00	\$0.00
Indep. Claims	0	- 3 =	0	x \$78.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$690.00
OTHER FEE (specify purpose)					\$0.00
TOTAL FILING FEE					\$690.00

- ☒ A check in the amount of **\$690.00** to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **50-0308** as described below. A duplicate copy of this sheet is enclosed.
- ☐ Charge the amount of _____ as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☒ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).


Signature

Dated: **June 13, 2000**

cc:

June 13, 2000

Attorney Docket No. CNA-018-DIV

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Re: New U.S. Patent Application
Title: PRECISION CONTINUOUS SURFACE GUIDED OPTICAL
MODULE CARRIER AND METHOD OF USING SAME
Inventors: William Keith Chandler, Andrei Csipkes, Thomas Boyer and
Charles Benner

TRANSMITTAL LETTER

Sir/Madam:

The above-referenced patent application is a divisional of application Serial No. 09/144,434, filed September 1, 1998. We enclose the following papers for filing in the United States Patent and Trademark Office in connection with the Divisional application.

1. Utility Patent Application Transmittal (Form P01ULRG/REV04)
2. Application - 28 pages;
3. Drawings - 7 sheets of formal drawings;
4. Copy of Declaration from prior application Serial No. 09/144,434;
5. Information Disclosure Statement and PTO Form 1449;

Certification Under 37 C.F.R. Section 1.10

I hereby certify that this Transmittal Letter and the documents referred to as enclosed therein is being deposited with the United States Postal Service on this 13th day of June, 2000 in an envelope marked as "Express Mail Post Office to Addressee" Mail Label Number EL358870406US addressed to Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Carol S. Parker-Hines

(type or print name of person mailing paper)

(signature of person mailing paper)

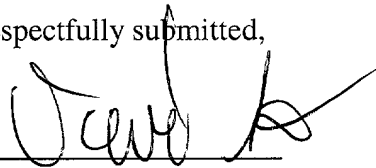
6. Check for \$690.00; and,
7. Preliminary Amendment canceling claims 1, 7, 10, 12, and 16-22.

If there are any other fees due in connection with the filing of this application, please charge the fees to our Deposit Account No. 50-0308. If a fee is required for an extension of time under 37 C.F.R. § 1.136 not accounted for above, such an extension is requested and the fee should also be charged to our Deposit Account.

Please accord this application a serial number and filing date.

Respectfully submitted,

By:


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Chandler, et al.)
)
Serial No.: Divisional Of) Group Art Unit: Unassigned
Application Serial)
No. 09/144,434)
)
Filed: June 13, 2000) Examiner: Unassigned
)
For: PRECISION CONTINUOUS SURFACE)
GUIDED OPTICAL MODULE CARRIER)
AND METHOD OF USING SAME)

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir/Madam:

PRELIMINARY AMENDMENT

Prior to the examination of the above application, please amend this application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, line 3 after "is", insert -- a divisional of U.S. Patent Application Serial No. 09/144,434, filed September 1, 1998 --.

IN THE CLAIMS:

Please cancel claims 1, 7, 10, 12, and 16-22.

REMARKS

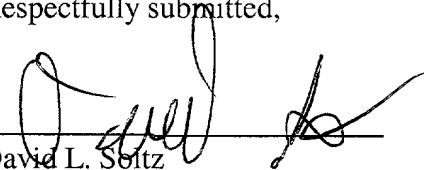
By this amendment, Applicant has amended the specification to appropriately reflect that the present application is a divisional of U.S. Application Serial No. 09/144,434, filed September 1, 1998 (the "parent case"). Applicants have further canceled claims 1, 7, 10, 12 and 16-22 which were examined and allowed in the parent case.

Entry of this preliminary amendment and examination of pending claims 2-6, 8, 9 and 11 is respectfully requested.

Respectfully submitted,

Dated: June 13, 2000

By:



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S P E C I F I C A T I O N

TITLE OF THE INVENTION

PRECISION CONTINUOUS SURFACE GUIDED OPTICAL MODULE CARRIER
AND METHOD OF USING SAME

BACKGROUND OF THE INVENTION

1) Field of the Invention

This invention pertains to the field of optical device testing and in particular to an apparatus and method for facilitating inspection of the surfaces of optical devices on an optical module.

2) Background of the Related Art

Optical devices combined with electronics are increasingly being used in communication and information systems. It is important to inspect the surfaces of the optical devices after final assembly onto an optical module to insure that the module will perform as expected.

Inspection of the optical device surfaces is typically performed at one or more optical inspection stations in an

optical test circuit on an optical bench or platform. An inspection station may typically include a microscope or an electronic imaging device or camera for inspecting the optical device(s). Each optical device surface is manually aligned with an optical device interface at one or more inspection stations and then inspected. A connector may be provided between an optical device interface of the inspection station and an optical device to be inspected.

Unfortunately, manual alignment is labor-intensive and somewhat difficult. A microscope or optical camera is typically heavy, rigid and fixed with little or no alignment flexibility. Likewise, the optical module is often heavy and rigid. Also, the degree of precision required for optical alignment precludes the use of flexible connectors between the microscope and the optical device.

Often during the alignment process, one or more optical device surfaces inadvertently strike against the platform or inspection apparatus, damaging the optical surface. This can necessitate costly repairs or even cause the module to be wasted. For example an optical module can cost \$50,000 or more, and it is not uncommon for repairs caused by damage to an optical device during inspection to amount to \$10,000.

Accordingly, it would be advantageous to provide an apparatus and method for easily bringing optical device surfaces reliably into alignment with inspection stations. It would also be advantageous to provide an apparatus and method which provides
5 an extra degree of freedom of movement when aligning an optical inspection station with an optical device on an optical module. It would further be advantageous to provide an automated apparatus and method which reduces the amount of labor involved in the process. Other and further objects and advantages will
10 appear hereinafter.

SUMMARY OF THE INVENTION

The present invention comprises an apparatus and method for facilitating inspection of the surfaces of optical devices on an optical module.

15 In one aspect of the invention, an optical module carrier is provided which includes means for conveying an optical module to one or more optical inspection stations in an optical test circuit. The carrier aligns optical devices on the module with each corresponding optical device interface for the optical
20 inspection stations.

In another aspect of the invention, an optical module inspection circuit automates the alignment and positioning of optical devices with respect to optical inspection stations. Each inspection station is located at a predetermined position on an optical platform. An optical module is automatically conveyed to position an optical device to be inspected at the corresponding optical inspection station on the optical platform.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a first embodiment of an optical module inspection circuit.

Figure 2 shows an embodiment of an optical module carrier.

Figure 3A shows a first embodiment of a tray for an optical module carrier.

Figure 3B shows a second embodiment of a tray for an optical module carrier.

Figure 4 shows an optical module mounted on an optical module carrier in an optical module inspection circuit.

Figure 5 shows a second embodiment of an optical module inspection circuit.

Figure 6 shows a third embodiment of an optical module inspection circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a preferred embodiment of an optical module inspection circuit 100. The optical module inspection circuit 100 includes an optical platform 110 upon which are arranged one or more optical inspection stations 120 at fixed positions. Each optical inspection station 120 may be mounted in a fixed position on the optical platform 110.

In a preferred embodiment, the optical module platform 110 has a low-friction or virtually frictionless top surface. The optical module platform 110 top surface may be coated with a silicone based coating or TEFLON®. Also, the top surface may be made more frictionless by providing an air cushion.

Each optical inspection station 120 includes an optical inspection apparatus 130 having an optical interface 140 located a fixed distance above the top of the optical platform 110. The optical inspection apparatus 130 may be, for example, a microscope or an electronic imaging device or camera. An inspector may use the optical inspection apparatus to inspect an edge or planar surface of an optical device.

To inspect each optical device mounted on an optical module, the optical device must be aligned with the optical interface 140 of the corresponding optical inspection station 120. In a preferred embodiment, an optical module is mounted on an optical module carrier 160 which conveys the optical module to each optical inspection station 120 in the optical module inspection circuit 100. The optical module carrier 160 is designed to place each optical device on the optical module the same distance above the top surface of the optical platform 110 as the optical interface 140 of the corresponding optical inspection station 120. This insures that the optical device is properly aligned with the optical inspection apparatus to prevent damage to the optical device.

A preferred embodiment of an optical module carrier 200 according to one or more aspects of the present invention is shown in Figure 2.

In the preferred embodiment of Figure 2, the optical module carrier 200 includes a tray 210 upon which an optical module may be mounted. The tray preferably has a flat top surface, or it may have a raised edge or lip along its outer top surface for helping to align or maintain the optical module in a fixed position with respect to the carrier.

In a preferred embodiment, the optical module carrier 200 also includes one or more vertically extending pillars 220 for securing the optical module into a fixed position on the top surface of the tray 210. The pillars 220 may be clamps which hold an optical module to the tray. Alternatively, the pillars 210 may include one or more slots for sliding an optical module into and thereby securing the optical module on the optical module carrier 200.

Optionally, the optical module and the optical module carrier may each include threaded holes which are aligned with corresponding holes in an optical module when the optical module is properly placed on the top surface of the optical module carrier 200. In that case, the optical module may be secured to the optical module carrier 200 by means of one or more screws or bolts.

In a preferred embodiment, the optical module carrier 200 includes one or more rollers 230 which may be used to transport the optical module carrier 200. In a preferred embodiment, the rollers may be balls (e.g., ball bearings) which partially extend through holes in the bottom surface of the tray 210. Alternatively, the rollers may be wheels, cylindrical rollers, or similar devices mounted to the bottom surface of the tray 210.

In a preferred embodiment, the optical module carrier 200 includes loaders which are spring loaded to provide an additional degree of freedom in the vertical direction. By applying pressure in a downward direction, the springs may be compressed and the vertical position of an optical module mounted on the optical module carrier may be precisely adjusted.

Figure 3A shows a first preferred embodiment of a tray 300 for an optical module carrier. In a preferred embodiment, the tray 300 may consist of a top portion 310 and a bottom cover plate 320 which are attached together. The top portion 310 and the bottom cover plate 320 may snap together, or they may be attached by any convenient means such as by screws, solder joints, welding etc. In a preferred embodiment, the top portion 310 has a plurality of recesses 330 in its bottom surface 340 which may accommodate balls 350. The recesses 330 also may be coated with Teflon or packed with lubricant to help the balls 350 to roll more freely. Corresponding to each recess 330, the bottom cover plate 320 has a hole 360 having a diameter which is slightly smaller than the diameter of the recess 330. The balls 350 are placed in the recesses 330 of the top portion 310 and the bottom cover plate 320 is then attached. Thus the balls 350 extend through the holes 360 a fixed distance below the bottom surface of the tray 300 such that they freely rotate in the holes

360. In this way, the optical module carrier may easily convey an optical module upon a top surface of an optical platform to one or more optical inspection stations while placing each optical device at the same distance above the top surface of the optical platform as the optical interface of the corresponding optical inspection station.

In some cases, the optical inspection stations each may have an optical interface which is a different distance above the top surface of the optical platform. In that case, the optical devices on an module each may need to be placed at different distances above the top surface of the optical platform to be aligned with the optical interface of the corresponding optical inspection station.

In a preferred embodiment, the optical module carrier tray 300 includes a spring 355 for each recess 330 and ball 350. The spring 355 allows the vertical positioning of the tray 300 to be adjusted slightly for precisely aligning an optical module with an optical device interface of an optical module inspection station.

Figure 3B shows a second preferred embodiment of a tray 370 for an optical module carrier which may also accommodate the need

to place different optical devices at different heights to align them with the optical device interfaces of corresponding inspection apparatuses. The tray 370 is similar to the tray 300 shown in Figure 3A except that it includes a top cover 375 and one or more elevation mechanisms 380. The elevation mechanism 380 may be used to raise or lower top cover 375 above the rest of the optical module carrier. In this way, an optical module may be raised or lowered so that each optical device on an optical module may be precisely positioned to match the distance above the top surface of the optical platform as the optical interface of the corresponding optical inspection station. Although Figure 3B shows a "scissors-type" elevation mechanism, one skilled in the art would recognize that many other elevation mechanisms could be incorporated into the optical module carrier to raise or lower the optical module.

Figure 4 shows an optical module inspection circuit 400 with an optical module carrier 405 on an optical platform 410 having two optical inspection stations 420. An optical module 460 is mounted on the optical module carrier 405.

The optical module 460 shown here includes a faceplate 462 and several bulkheads 464 which house optical device surfaces to be inspected at the inspection stations 420. The bulkheads 462

may include an optical connector for interfacing with a microscope or electronic imaging device.

The optical module carrier 405 includes two vertical pillars 425 having slots for holding the optical module 460. The optical module carrier 405 also includes a tray 430 for conveying the optical module 460 along the top surface of the optical platform 410. As shown here, the vertical pillars 425 are attached to the tray 430 by means of a plate 435.

In a preferred embodiment, the optical module carrier 405 may be fabricated of aluminum or another lightweight metal, plastic, or another appropriate material.

As described above, in a preferred embodiment, the tray 430 includes a plurality of rollers such as ball bearings on a bottom surface for smoothly conveying the optical module to an optical inspection station 420. Also, in a preferred embodiment, the top surface of the optical platform 410 is made to have low friction using, for example, a silicone based coating.

Figure 5 shows a preferred embodiment of an automated optical module inspection circuit 500. The optical module inspection circuit 500 includes an optical platform 510 upon

which are arranged one or more optical inspection stations 520 at fixed positions. Each optical inspection station 520 includes an optical inspection apparatus 530 having an optical interface 540 located a fixed distance above the top of the optical platform 510.

The optical module inspection circuit 500 also includes a movable arm 550 extendable from a base 555 over the surface of the optical platform 510. In a preferred embodiment, the movable arm 550 is attached to an optical module carrier 560 which conveys an optical module to each optical inspection station 520 in the optical module inspection circuit 500. The optical module carrier 560 is designed to place each optical device on the optical module the same distance above the top surface of the optical platform 510 as the optical interface 540 of the corresponding optical inspection station 520. This insures that the optical device is aligned with the optical inspection apparatus to prevent damage to the optical device.

Preferably, the movable arm 550 is mechanically controlled by one or more signals from a programmable processor 570 to automatically position the optical module at one or more optical inspection stations 520 on the optical platform 510. In that case, the processor 570 executes a program which divides the top

surface of the optical platform 510 into an X-Y Cartesian coordinate grid. The X-Y coordinates for the optical interface 540 of each optical inspection station 520 are stored in processor memory, and the processor 570 executes a software
5 program to automatically position the movable arm 550 at the X-Y coordinates for each optical interface in order to inspect an optical device on an optical module.

Preferably, the processor 570 has one or more data entry devices such as a keyboard 582, a mouse 584, a graphics tablet 586 and/or a light pen 588. The processor 570 also has a display
10 device such as a monitor 590.

Preferably, the processor 570 executes a first training routine for storing in memory the X-Y coordinates for each optical interface 540 of the optical inspection stations 520
15 along the optical platform 510. The movable arm 550 is steered to the proper location for each optical inspection station 520 either manually or under computer control. The arm is positioned so that an optical module on the optical module carrier 560 is properly positioned and oriented to align an optical device with
20 the optical interface 540 for the corresponding optical inspection station 520. Then the corresponding X-Y coordinate of the optical interface 540 is manually or automatically stored

into memory by the processor 570. This process is repeated for each optical inspection station 520 in the optical module inspection circuit 500.

5 The processor 570 also executes a second inspection routine for controlling the movable arm 550 to automatically position an optical device on an optical module to be inspected at the optical interface 540 of the corresponding optical inspection station 520 on the optical platform 510. A user may enter an identification number for an inspection station 520 and the processor 570 retrieves the corresponding X-Y coordinates of the optical interface 540 from memory. The processor 570 then supplies control signals to the movable arm 550 to move it to align the optical device to be inspected with the optical interface 540 for the corresponding optical inspection station 520. This is repeated for each optical device and each inspection station in the optical module inspection circuit 500.

15 In a variation of the first preferred embodiment of an automated optical module inspection circuit, the movable arm may also move the optical module carrier in the Z dimension above the top surface of the optical platform 510. This may allow the movable arm to automatically place different optical device on an

20

module at different heights above the top surface of the optical platform to align them with corresponding inspection apparatuses.

In that case, during the training routine, the Z coordinate for each optical interface 540 of the optical inspection stations 520 along the optical platform 510 is stored in memory along with the X-Y coordinates. Likewise, during the inspection routine the movable arm 550 automatically positions each optical device on an optical module to be inspected at the proper X, Y and Z coordinates for the optical interface 540 of the corresponding optical inspection station 520 on the optical platform 510.

Figure 6 shows another preferred embodiment of an automated optical module inspection circuit 600. The optical module inspection circuit 600 includes an optical platform 610 upon which are arranged one or more optical inspection stations 620 at fixed positions. Each optical inspection station 620 includes an optical inspection apparatus 630 having an optical interface 640 located a fixed distance above the top of the optical platform 610.

The optical module inspection circuit 600 also includes an optical module carrier 660 which conveys an optical module to each optical inspection station 620 in the optical module

inspection circuit 600. The optical module carrier 660 is designed to place each optical device on the optical module the same distance above the top surface of the optical platform 610 as the optical interface 640 of the corresponding optical inspection station 620. This insures that the optical device is aligned with the optical inspection apparatus to prevent damage to the optical device.

Preferably, the optical module carrier 660 is mechanically controlled by one or more signals from a programmable processor 670 to automatically position the optical module at one or more optical inspection stations 620 on the optical platform 610. Preferably, the optical module carrier 660 includes an electrical motor for turning rolling means 665 which transport the optical module carrier 660. The rolling means 665 may be wheels, cylindrical rollers, similar devices mounted to the bottom surface of the optical module carrier 660.

Preferably, the top surface of the optical platform 610 is divided into an X-Y Cartesian coordinate grid. The X-Y coordinates for the optical interface 640 of each optical inspection station 620 are stored in processor memory, and the processor 670 executes a software program to automatically position the optical module at the X-Y coordinates for each

optical interface in order to inspect an optical device on an optical module.

Preferably, the processor 670 has one or more data entry devices such as a keyboard 682, a mouse 684, a graphics tablet 686 and/or a light pen 688. The processor 670 also has a display device such as a monitor 690.

Preferably, the processor 670 executes a first training routine for storing in memory the X-Y coordinates for each optical interface 640 of the optical inspection stations 620 along the optical platform 610. The optical module carrier 660 is steered to the proper location for each optical inspection station 620 either manually or under computer control. The optical module carrier 660 is positioned so that an optical module mounted thereon is properly positioned and oriented to align an optical device with the optical interface 640 for the corresponding optical inspection station 620. Then the corresponding X-Y coordinate of the optical interface 640 is manually or automatically stored into memory by the processor 670. This process is repeated for each optical inspection station 620 in the optical module inspection circuit 600.

The processor 670 also executes a second inspection routine for transporting the optical module carrier 660 to automatically position an optical device on an optical module to be inspected at the optical interface 640 of the corresponding optical inspection station 620 on the optical platform 610. A user may enter an identification number for an inspection station 620 and the processor 670 retrieves the corresponding X-Y coordinates of the optical interface 640 from memory. The processor 670 then supplies control signals to the optical module carrier 660 to move it to align the optical device to be inspected with the optical interface 640 for the corresponding optical inspection station 620. This is repeated for each optical device and each inspection station in the optical module inspection circuit 600.

In a variation of the second preferred embodiment of an automated optical module inspection circuit, the optical module carrier may include automatic means for elevation in the Z dimension above the top surface of the optical platform 610. This may allow the optical module carrier 660, under control of the processor 670, to automatically place different optical device on an module at different heights above the top surface of the optical platform to align them with corresponding inspection apparatuses.

By the above-described system and process, optical devices may be quickly aligned for inspection without risk of damage.

While preferred embodiments are disclosed herein, many variations are possible which remain within the concept and scope of the invention. Such variations would become clear to one of ordinary skill in the art after inspection of the specification, drawings and claims herein. The invention therefore is not to be restricted except within the spirit and scope of the appended claims.

CLAIMS

What is claimed is:

1. An optical module carrier for conveying an optical module to one or more stations in an optical test circuit, said optical module carrier comprising:

a tray having a top surface for supporting the optical module; and

a plurality of rollers for conveying said tray, said rollers each mounted in a bottom surface of said tray, each of said rollers extending a fixed distance below the bottom surface of said tray.

2. The optical module carrier of claim 1, further comprising vertical pillars for securing said optical module on the top surface of the optical module carrier.

3. The optical module carrier of claim 2, wherein at least one said vertical pillars clamps said optical module onto the top surface of the optical module carrier.

4. The optical module carrier of claim 2, wherein at least one said vertical pillars includes a slot for holding said optical module carrier.

5. The optical module carrier of claim 1, further comprising a plurality of springs corresponding to said plurality of rollers, each of said springs mounted in the bottom surface of said tray between said plurality of rollers and said optical
5 module carrier.

6. The optical module carrier of claim 5, wherein each of said plurality of rollers is a ball.

7. An optical module carrier for conveying an optical module to one or more stations in an optical test circuit, said carrier comprising:
10

base means for supporting the optical module, said base means having a top surface and a bottom surface;

securing means for securing the optical module to the top surface of said base means; and

15 rolling means for conveying said base means, said rolling means attached to the bottom surface of said base means, said rolling means extending a fixed distance below the bottom surface of said base means.

8. The optical module carrier of claim 7, further comprising
20 means for elevating said optical module a desired distance above the bottom surface of said base means.

9. The optical module carrier of claim 7, wherein said rolling means comprises a plurality of balls.

10. An apparatus for inspecting an optical device on an optical module, comprising:

5 an optical platform;

an inspection station disposed along a top surface of said optical platform having an optical device interface located a fixed distance above the top surface of said optical platform; and

10 an optical module carrier for holding the optical module and conveying the optical module along the top surface of said optical platform to the inspection station, said optical module carrier positioning said optical device at a distance above the optical platform corresponding to the fixed distance said optical device interface is located above the top surface.

11. The apparatus of claim 10 wherein said optical platform has a top surface coated with a silicone based coating.

12. The apparatus of claim 10, wherein said optical inspection station comprises a microscope.

13. The apparatus of claim 10, wherein said optical module carrier further comprises:

a tray having a top surface for supporting the optical module; and

5 a plurality of rollers for conveying said tray, said rollers each mounted in a bottom surface of said tray, each of said rollers extending a fixed distance below the bottom surface of said tray.

14. The apparatus of claim 10, wherein said optical module carrier further comprises:

vertical pillars for securing said optical module on the top surface of the optical module carrier.

15. The apparatus of claim 13, wherein said optical module carrier further comprises:

15 a plurality of springs corresponding to said plurality of rollers, each of said springs mounted in the bottom surface of said tray between said plurality of rollers and said optical module carrier.

20 16. A method of inspecting an optical device on an optical module at an optical module test station located on an optical platform, wherein the optical module test station has an optical

device interface located a fixed distance above a top surface of the optical platform, said method comprising:

securing the optical module to a top surface of an optical module carrier having rolling means for conveyance;

5 conveying the optical module to the optical module test station along a top surface of the optical platform such that the optical device is located a fixed distance above the top surface of said optical platform; and

10 inspecting the optical device at the optical module test station.

17. An apparatus for inspecting an optical device on an optical module, comprising:

an optical platform having a top surface divided into an X-Y Cartesian coordinate grid;

15 an inspection station disposed along a top of said optical platform having an optical device interface located at a predetermined X-Y coordinate along said Cartesian coordinate grid, said optical device interface located a fixed distance above the top surface of said optical platform;

20 an optical module carrier for holding the optical module, said optical module carrier positioning said optical device at a distance above the optical platform corresponding to the fixed

distance said optical device interface is located above the top surface; and

means for automatically conveying the optical module along a top surface of said optical platform to the predetermined X-Y coordinate where said optical interface of said inspection station is located.

18. The apparatus of claim 17, wherein said means for automatically conveying the optical module comprises a movable arm attached to said optical module carrier.

19. The apparatus of claim 18, wherein said means for automatically conveying the optical module further comprises:

a programmable processor for executing a program for providing control signals to control said movable arm; and

memory for storing data identifying said predetermined X-Y coordinate along said Cartesian coordinate grid where said optical interface of said inspection station is located.

20. The apparatus of claim 17, wherein said means for automatically conveying the optical module comprises:

rolling means for transporting said optical module carrier;

and

an electric motor for turning said rolling means.

21. The apparatus of claim 20, wherein said means for automatically conveying the optical module further comprises:

a programmable processor for executing a program for providing control signals to control said movable arm; and

5 memory for storing data identifying said predetermined X-Y coordinate along said Cartesian coordinate grid where said optical interface of said inspection station is located.

22. A method of inspecting an optical device on an optical module at an optical module test station located on an optical platform having a top surface divided into an X-Y Cartesian coordinate grid, wherein the optical module test station has an optical device interface located at a predetermined X-Y coordinate along the Cartesian coordinate grid and at a fixed distance above the top surface of the optical platform, said method comprising:

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securing the optical module to a top surface of an optical module carrier having rolling means for conveyance;

placing the optical module carrier on the top surface of the optical platform;

20 automatically conveying said optical module to the predetermined X-Y coordinate and positioning said optical device at a distance above the optical platform corresponding to the

fixed distance said optical device interface is located above the top surface; and

inspecting the optical device at the optical module test station.

ABSTRACT OF THE DISCLOSURE

An optical module inspection circuit on an optical platform includes an optical module carrier for precisely aligning optical devices with optical interfaces of inspection equipment located at fixed positions in the optical module inspection circuit. The module includes an apparatus for conveyance along a top surface of the optical platform. The module may be conveyed automatically to predetermined positions on the optical platform to automate alignment and positioning of optical devices with respect to optical inspection stations in the optical test circuit.

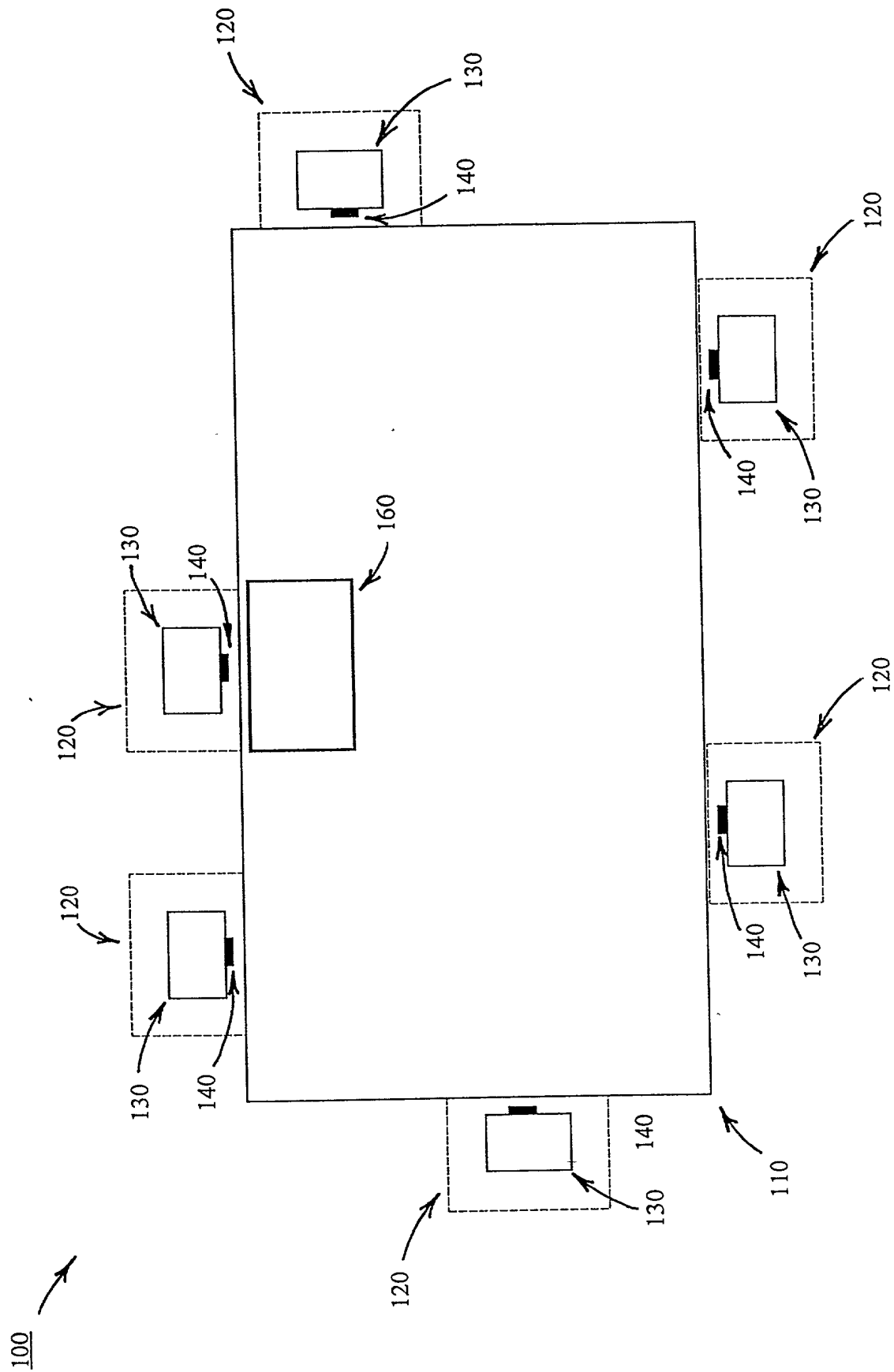


Figure 1

200

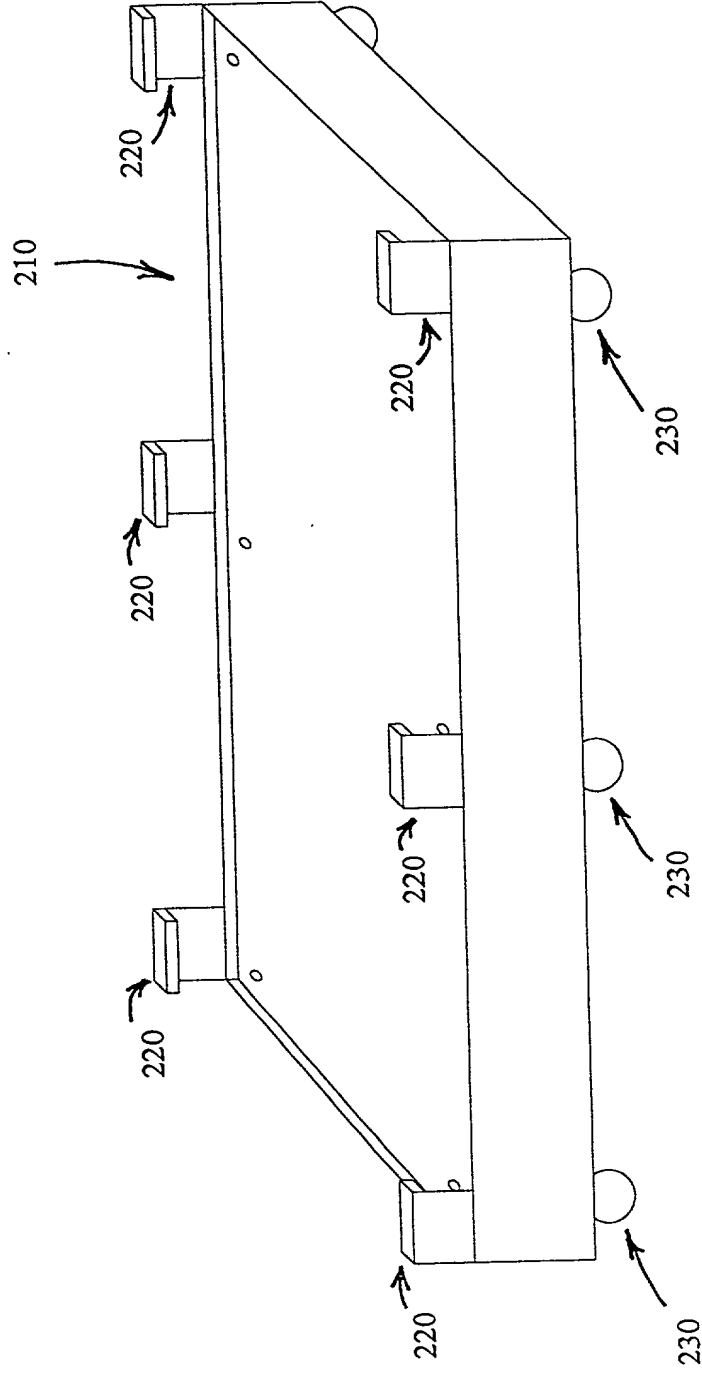


Figure 2

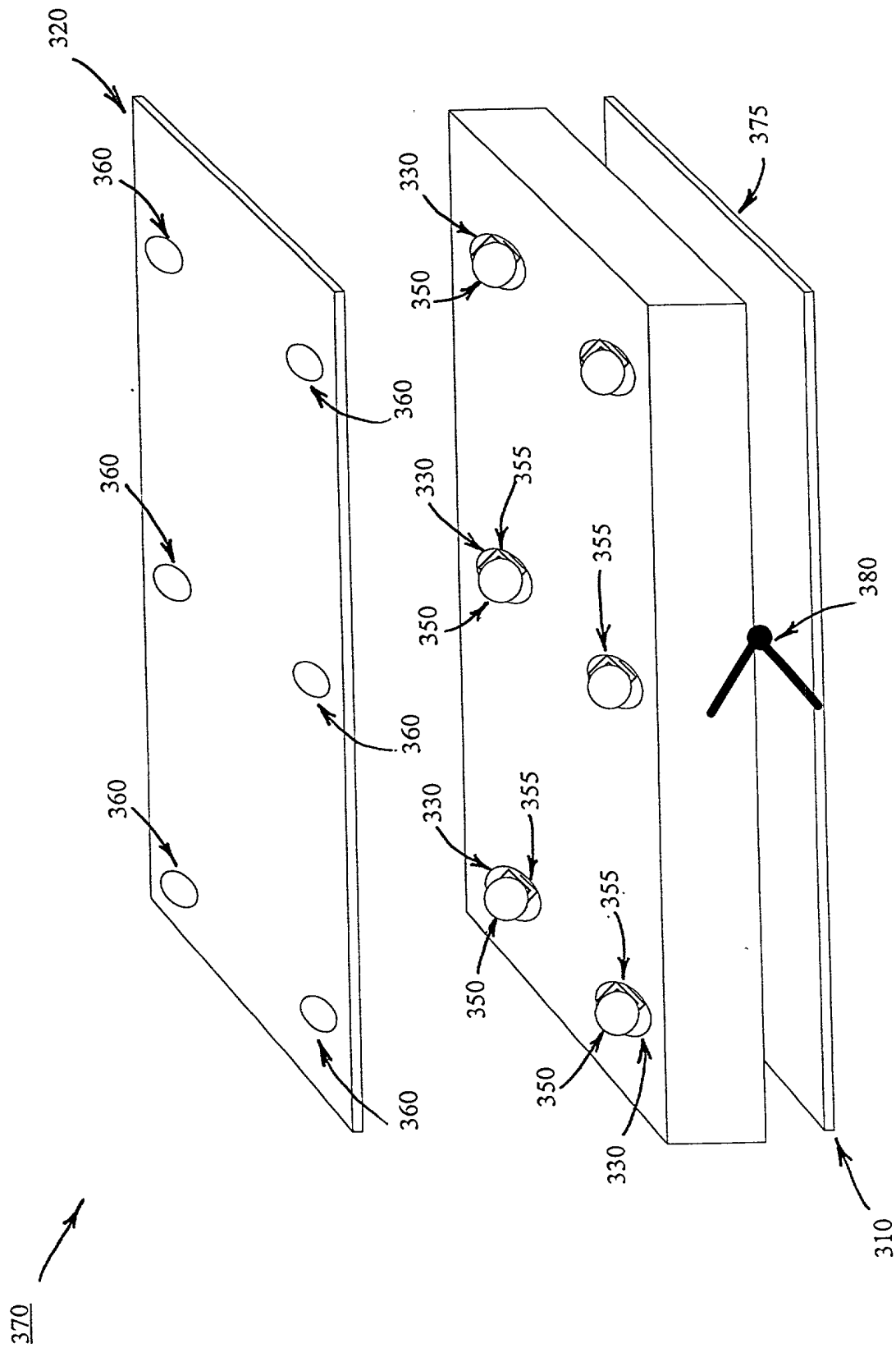


Figure 3B

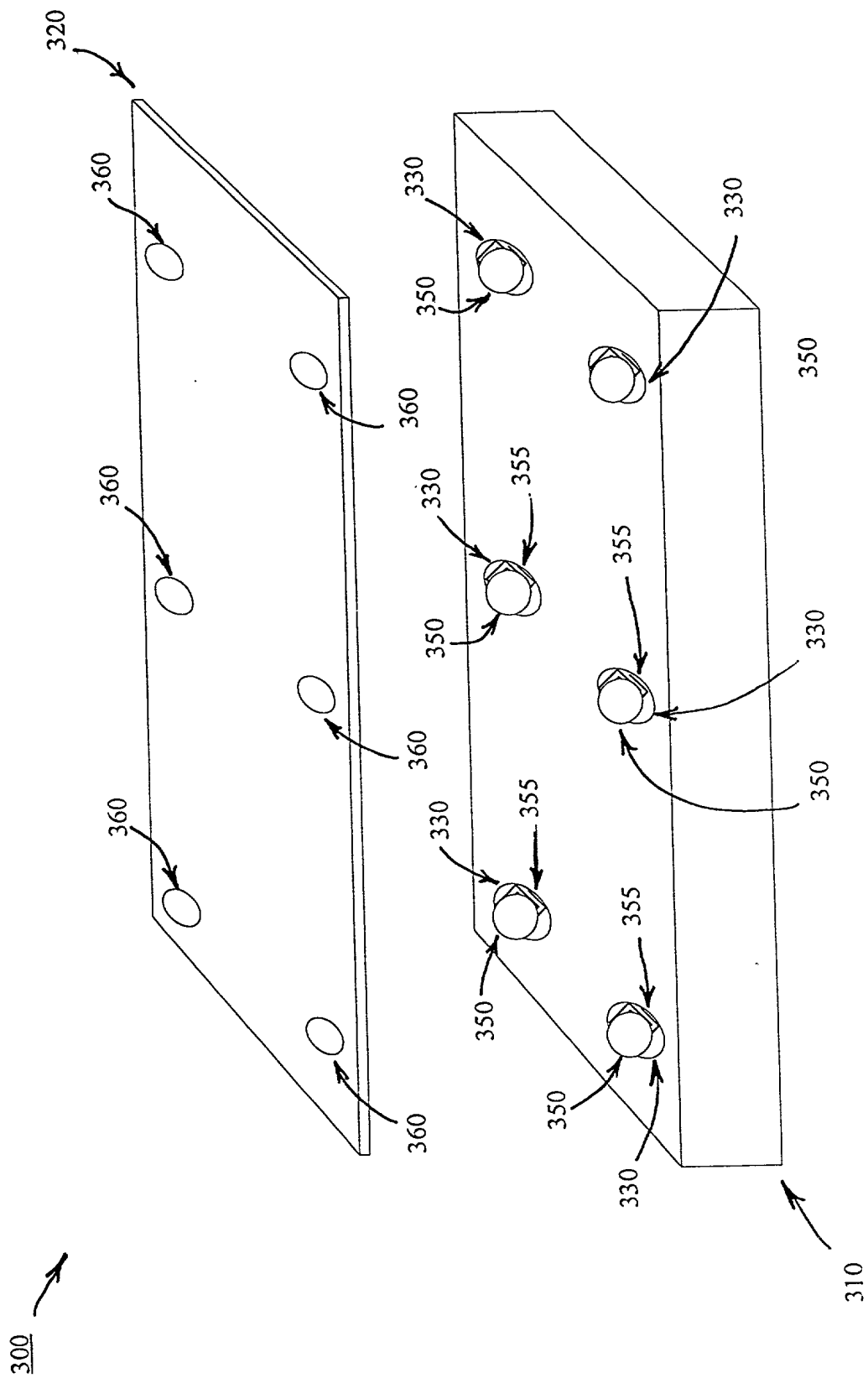


Figure 3A

400

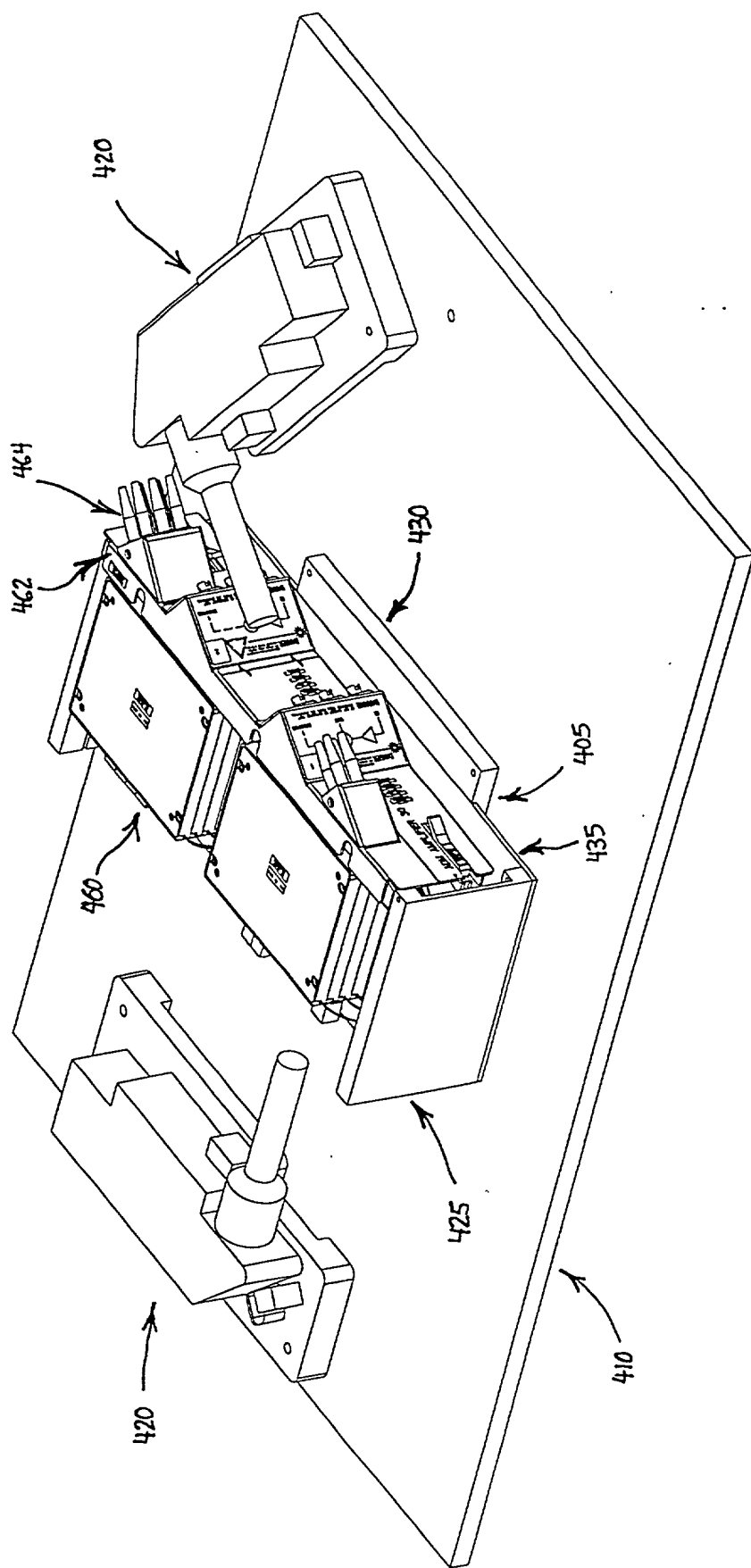


Figure 4

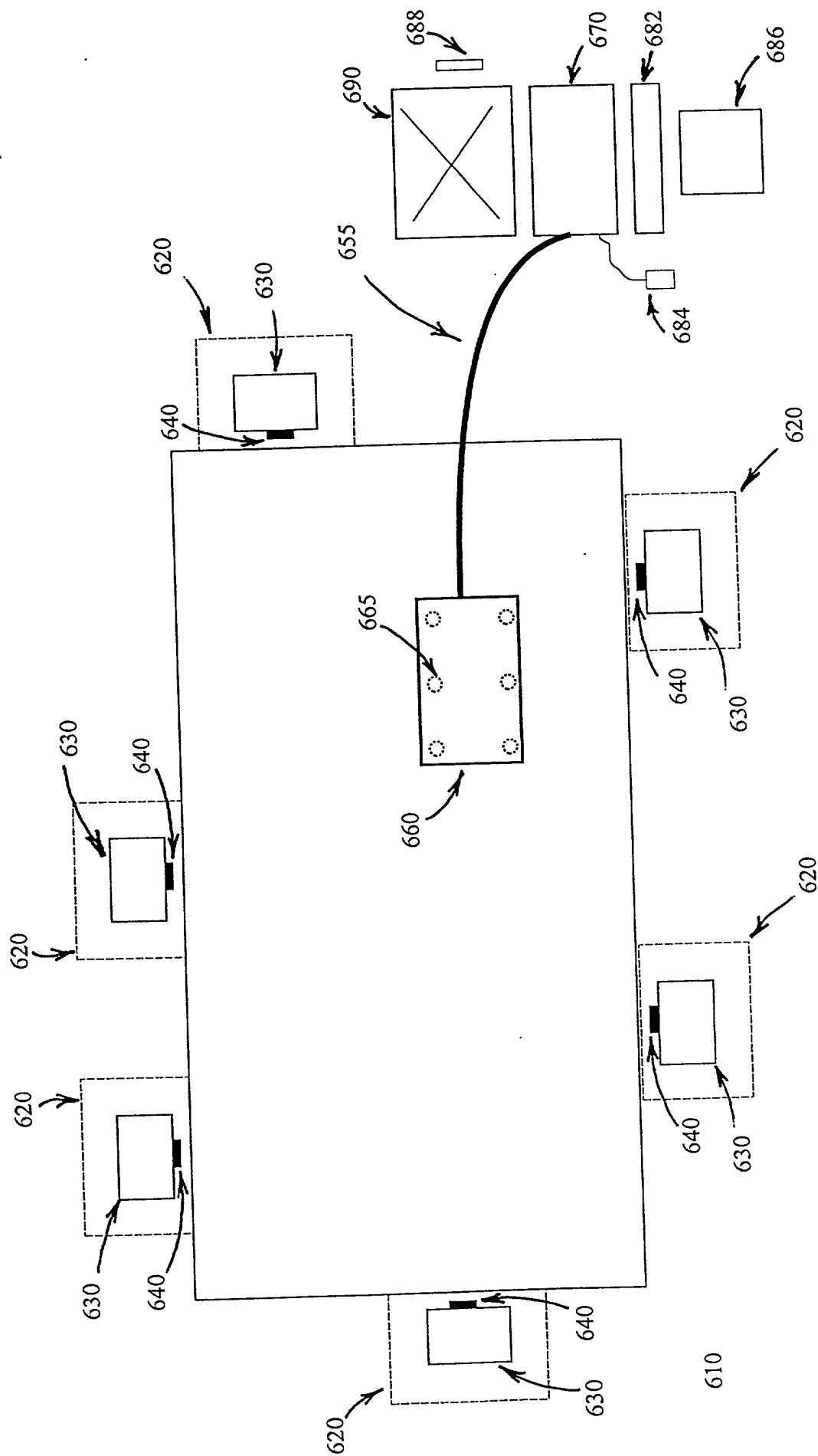


Figure 6

DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

(x) Original () Supplemental () Substitute () PCT () Design

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE: PRECISION CONTINUOUS SURFACE GUIDED OPTICAL MODULE
CARRIER AND METHOD OF USING SAME

of which is described and claimed in:

(x) the attached specification, *or*

() the specification in the application Serial No. _____ filed _____,

and with amendments through _____ (if applicable), *or*

() the specification in International Application No. PCT/ _____, filed _____,

and as amended on _____ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint Raymond C. Jones, Reg. No. 34,631, Adam C. Volentine, Reg. No. 33,289, Brian C. Altmiller, Reg. No. 37,271, and Kenneth D. Springer, Reg. No. 39,843, members of the firm of JONES & VOLENTINE, LLP., jointly and severally, attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

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I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Applicant Reference No.: _____

Atty Docket No.: _____ CNA.018